

(A) Improvements in the feathering resistance can be obtained by the combination of the claimed characteristics of the resin film of the resin laminated metal sheet and the claimed production process; and

(B) The die conditions specified in the claims (i.e., die radius of top and bottom dies) optimum for the composite cold-forming.

POINT A

According to the present invention, the feathering resistance can be improved as the result of (a) recovery of the adhesive force of the film at the processed portion and (b) the decrease in the elongation due to the crystallization of the resin film achieved by composite cold-forming a laminated metal sheet coated with a resin film having the physical properties specified in the claims, followed by heat treating after the cold-forming at the temperature conditions specified in the claims.

Namely, the inventors discovered conditions for the claim specified film properties and the claim specified heat treatment temperature which are necessary to satisfy both the perfection of the film during the composite cold-forming (i.e., repair coating after the cold-forming is not necessary) and the improvement in the feathering resistance.

The film, before the cold-forming, is a crystalline saturated polyester resin film having an elongation of at least 150%, a crystallinity of not more than 10%, and a crystalline heat of fusion of not less than 10 joules/g. The heat treatment temperature after the cold-forming is at least the crystallization starting temperature and less than the melting point. The resin film properties (or characteristics) obtained after the heat treatment are an elongation of not more than 100% and a crystallinity of not less than 20%.

The above-mentioned essential features of the present invention and the advantageous results obtained therefrom are completely absent in the cited references.

Oyagi et al. disclose a sheet steel easy-open can lid made by a resin-laminated sheet steel which does not require the repair coating.

However, Oyagi neither discloses nor suggests in any manner the following essential features of the present invention.

(a) The heat treatment of the resin film after the composite cold-forming under the claim specified conditions; and

(b) The changes in the resin film properties (or characteristics) caused by the heat treatment.

Layre et al. proposes an improvement in the feathering resistance by the provision of a guide groove (or pre-inclusion or furrow) shown in Figs. 2a and 2b on the thermoplastic film using a resin film. However, according to Layre, the feathering resistance is improved by using, for example, a laser beam as a concentrated heat source and by forming the shape of the resin film as shown in Figs. 2a and 2b. This is completely different from the present invention wherein the tear-along groove is formed, followed by heat treating the resin layer around the tear-along groove.

Consequently, the technical idea of the present invention is neither disclosed nor suggested in the cited Oyagi et al. and Layre et al. references. Likewise, Iioka and Matsubayashi do not disclose or suggest these features of the present invention.

Point (B)

According to the present invention, in order to ensure the easy-opening of the can, without damaging or breaking the resin film, the composite cold-forming should be carried out by using top and bottom dies of a die radius of 0.1 to 1.0 mm as defined in the claims.

When the die radius is less than 0.1 mm, the impression portion of the die radius is sharp with the result that the laminated resin film of the processed material is damaged or broken during the processing. When the composite cold-forming is performed by a die radius of more than 1.0 mm, the material is subjected to composite cold-forming over more than a necessary portion and the adhesion between the metal and resin becomes poorer. Formation of poor adhesion portions is the reason behind feathering. Further, poor adhesion portions of the coated film are not desirable from the viewpoint of corrosion resistance.

Contrary to the above, Oyagi neither discloses nor suggests the above-mentioned conditions or requirements of the dies to be used during the composite cold-forming according to the present invention. Likewise, Layre, Iioka and Matsubayashi do not disclose or suggest the features of the dies of the present invention.

According to Iioka et al., ribbon breaking is only prevented by forming a reinforcing layer of a thermoplastic resin. This does not disclose or suggest the present invention.